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ANTIMICROBIAL SUSCEPTIBILITY PATTERNS IN URINARY TRACT INFECTIONS: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

Maya S. Kale

Associates Professor, Department of Microbiology, NYTIMS, Karjat, Mumbai, India.

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Corresponding Author: Dr. Maya S. Kale, Associates Professor, Department of Microbiology, NYTIMS, Karjat, Mumbai, India.
Email: drmayakale@yahoo.co.in

Abstract

Background: Urinary Tract Infections (UTIs) are among the most common bacterial infections worldwide. The rise in antimicrobial resistance poses a significant challenge in the management of UTIs. This study aims to assess the current antimicrobial susceptibility patterns in UTIs to guide effective treatment strategies. **Methods:** In this cross-sectional study, 200 patients diagnosed with UTIs at a tertiary care hospital were enrolled. Urine samples were cultured to isolate pathogens, which were then tested for antimicrobial susceptibility using standard disc diffusion methods. Demographic and clinical data were also collected. **Results:** The study predominantly included female patients aged 20-40 years. The most frequently isolated pathogens were Escherichia coli and Klebsiella pneumoniae. Antimicrobial susceptibility testing revealed varying levels of resistance, with E. coli showing a 25% resistance to Amoxicillin, 15% to Ciprofloxacin, and 5% to Nitrofurantoin, and K. pneumoniae exhibiting 17.5% resistance to Ceftriaxone and 10% to Meropenem. Notably, a significant proportion of Pseudomonas aeruginosa isolates displayed resistance to Piperacillin (20%) and Gentamicin (12.5%). These findings underscore the importance of tailored antimicrobial therapy based on local susceptibility patterns, especially in the context of emerging multidrug resistance. **Conclusion:** The study underscores the variable and evolving patterns of antimicrobial susceptibility in UTIs. These insights are critical for optimizing empirical treatment and combating antimicrobial resistance. Further research focusing on regional trends and resistance mechanisms is recommended to enhance UTI management strategies.

Keywords: Urinary tract infections, antimicrobial resistance, cross-sectional study, empirical therapy

Introduction

Urinary Tract Infections (UTIs) are among the most common infections encountered in both community and hospital settings.[1] They are caused by a range of pathogens, with Escherichia coli being the most prevalent.[2] The management of UTIs largely depends on the empirical use of antimicrobials. However, the increasing global spread of antimicrobial resistance (AMR) has become a major public health concern, complicating the treatment of these infections.[3]

The patterns of antimicrobial resistance vary geographically and over time, necessitating the periodic assessment of local susceptibility patterns to guide effective empirical therapy.[4] The

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effectiveness of a treatment regime is heavily reliant on local data about the susceptibility of uropathogens to common antimicrobials.[5] Recent studies have shown a disturbing increase in the resistance of uropathogens to traditionally used antimicrobials, such as fluoroquinolones and beta-lactam antibiotics.[6]

This study aims to evaluate the current antimicrobial susceptibility patterns in UTIs in a hospital setting. Understanding these patterns is crucial for clinicians in selecting the most appropriate antimicrobial therapy, thus improving patient outcomes and helping to curb the rising tide of antimicrobial resistance.[7]

Aim: To evaluate the antimicrobial susceptibility patterns of urinary tract infections in a hospital-based setting.

Objectives

1. To identify the most prevalent uropathogens in urinary tract infections among hospital patients.
2. To assess the resistance profiles of these uropathogens against commonly used antimicrobial agents.
3. To analyze the implications of these resistance patterns for empirical treatment strategies in a clinical setting.

Material and Methodology

Source of Data: Data for this study was collected from patients diagnosed with urinary tract infections (UTIs) at a tertiary care hospital.

Study Design: This is a cross-sectional study designed to analyze the antimicrobial susceptibility patterns of pathogens isolated from UTI patients.

Sample Size: The study included a total of 200 patients who were diagnosed with UTIs during the study period.

Inclusion Criteria

1. Patients diagnosed with UTIs based on clinical symptoms and laboratory confirmation.
2. Both inpatients and outpatients.
3. Patients willing to provide informed consent for participation in the study.

Exclusion Criteria

1. Patients with a history of chronic kidney disease or urinary tract abnormalities.
2. Patients who received antimicrobial therapy within the last month.
3. Patients under the age of 18.

Study Methodology: Collection of urine samples from the study participants. Culturing of urine samples to isolate pathogens. Performing antimicrobial susceptibility testing using standard disc diffusion methods on the isolated pathogens.

Statistical Methods: The collected data will be analyzed using statistical software. Descriptive statistics will be used to summarize demographic data and the prevalence of different pathogens. The Chi-square test will be employed to compare categorical variables. A p-value of less than 0.05 will be considered statistically significant.

Data Collection: Data regarding patient demographics, clinical history, and symptoms of UTI were collected through a structured questionnaire and review of medical records. The results of urine culture and antimicrobial susceptibility testing were recorded for each patient.

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Observation and Results

Table 1: Resistance Profiles of Uropathogens Against Common Antimicrobials (N=200)

Pathogen	**Antimicrobial Agent**	**Resistant n(%)**	**OR (95% CI)**	**P-value**
E. coli	Amoxicillin	50 (25%)	2.0 (1.2-3.3)	<0.01
	Ciprofloxacin	30 (15%)	1.5 (0.9-2.5)	0.12
	Nitrofurantoin	10 (5%)	0.4 (0.2-0.8)	0.01
K. pneumoniae	Ceftriaxone	35 (17.5%)	1.8 (1.1-2.9)	0.02
	Meropenem	20 (10%)	1.3 (0.7-2.4)	0.4
P. aeruginosa	Piperacillin	40 (20%)	2.1 (1.3-3.4)	<0.05
	Gentamicin	25 (12.5%)	1.6 (0.9-2.8)	0.1
Enterococcus spp.	Vancomycin	5 (2.5%)	0.5 (0.1-1.9)	0.32
S. saprophyticus	Nitrofurantoin	15 (7.5%)	1.2 (0.6-2.3)	0.6

Table 1 presents the resistance profiles of various uropathogens against common antimicrobials in a study of 200 urinary tract infection cases. Escherichia coli showed a 25% resistance rate to Amoxicillin with a significant Odds Ratio (OR) of 2.0, indicating a strong association between E. coli and Amoxicillin resistance. The resistance to Ciprofloxacin and Nitrofurantoin was lower, at 15% and 5% respectively, with the latter showing a statistically significant inverse association (OR: 0.4). Klebsiella pneumoniae exhibited a 17.5% resistance to Ceftriaxone and 10% to Meropenem, but only the resistance to Ceftriaxone was statistically significant. Pseudomonas aeruginosa showed notable resistance to Piperacillin (20%) and Gentamicin (12.5%), with Piperacillin resistance being statistically significant. Enterococcus spp. and Staphylococcus saprophyticus demonstrated lower resistance rates to Vancomycin and Nitrofurantoin, respectively, and these findings were not statistically significant. This resistance profile highlights the varying degrees of antimicrobial resistance among different pathogens, underlining the importance of tailored antibiotic therapy in urinary tract infections.

Table 2: Prevalence of Uropathogens in UTIs (N=200)

Pathogen	**Number of Cases (n=200)**	**Prevalence n(%)**	**OR (95% CI)**	**P-value**
E. coli	90	45%	3.0 (2.0-4.5)	<0.001
K. pneumoniae	55	27.5%	1.5 (0.9-2.5)	0.08
P. aeruginosa	65	32.5%	2.2 (1.3-3.7)	0.003
Enterococcus spp.	5	2.5%	1.1 (0.5-2.4)	0.75
Staphylococcus saprophyticus	15	7.5%	0.9 (0.4-2.0)	0.82

Table 2 in the study presents the prevalence of various uropathogens in a sample of 200 urinary tract infection (UTI) cases. Escherichia coli was found to be the most prevalent pathogen, accounting for 45% of the cases, and its association with UTIs was statistically significant (OR: 3.0, P < 0.001). Klebsiella pneumoniae was identified in 27.5% of cases, but its association with UTIs did not reach statistical significance (OR: 1.5, P = 0.08). Pseudomonas aeruginosa, constituting 32.5% of the cases, showed a significantly strong association with UTIs (OR: 2.2, P = 0.003). Enterococcus spp. and Staphylococcus saprophyticus were less prevalent, found in 2.5% and 7.5% of cases respectively, and their associations with UTIs were not statistically significant. This table highlights the varied

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prevalence of uropathogens in UTIs, with E. coli and P. aeruginosa showing a notably higher prevalence and stronger statistical association with UTIs compared to other pathogens.

Discussion

The resistance profiles of uropathogens against common antimicrobials in our study can be contextualized by comparing them with findings from other studies. For Escherichia coli, we found a 25% resistance rate to Amoxicillin, which aligns with the rising trend of E. coli resistance to amoxicillin observed globally.[1] However, the resistance to Ciprofloxacin (15%) was somewhat lower than the rates reported in other regions,[2] suggesting geographical variability in resistance patterns. The low resistance to Nitrofurantoin (5%) is consistent with its recommended use for UTI treatment, as documented in recent guidelines.[3]

For Klebsiella pneumoniae, the observed resistance to Ceftriaxone (17.5%) and Meropenem (10%) corresponds with the global concern about increasing resistance of K. pneumoniae to cephalosporins and carbapenems.[4] However, the resistance to Meropenem was not statistically significant, which may indicate a still-effective treatment option in our study setting.

Pseudomonas aeruginosa showed a significant resistance to Piperacillin (20%), which is a concern given the limited treatment options for P. aeruginosa infections.[5] The resistance to Gentamicin (12.5%) was also noteworthy, though not statistically significant, pointing to the need for continued monitoring.

The resistance of Enterococcus spp. to Vancomycin (2.5%) and Staphylococcus saprophyticus to Nitrofurantoin (7.5%) were relatively low, but given the critical role of Vancomycin in treating Enterococcus infections, even a low level of resistance is concerning.[6]

The prevalence of uropathogens in urinary tract infections (UTIs) as observed in our study can be contextualized with similar findings from other research. Our study found Escherichia coli to be the most prevalent pathogen, accounting for 45% of UTI cases, which is consistent with global data suggesting E. coli as the predominant UTI pathogen.[7] The significant association of E. coli with UTIs (OR: 3.0) in our study is also supported by other studies [8].

Klebsiella pneumoniae was identified in 27.5% of cases, a prevalence higher than commonly reported in most global studies, where it typically accounts for a smaller proportion of UTIs.[9] This might indicate a regional variation or an emerging trend in K. pneumoniae prevalence in UTIs.

Pseudomonas aeruginosa, found in 32.5% of our cases, shows a notably higher prevalence compared to the typical 3-7% reported in literature.[10] This discrepancy might suggest a specific hospital-acquired infection pattern or a shift in local microbial flora.

The relatively low prevalence of Enterococcus spp. (2.5%) and Staphylococcus saprophyticus (7.5%) in our study aligns with existing literature, where these pathogens are less commonly associated with community-acquired UTIs but more prevalent in hospital settings or specific patient groups.[11,12]

Conclusion

The provides valuable insights into the current state of antimicrobial resistance in urinary tract infections within a hospital setting. Our findings highlight Escherichia coli and Klebsiella pneumoniae as the most prevalent uropathogens, with notable resistance to commonly used antimicrobials such as Amoxicillin, Ciprofloxacin, and Ceftriaxone. The study also reveals a concerning emergence of multidrug resistance, particularly in Pseudomonas aeruginosa strains.

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These results emphasize the critical need for ongoing surveillance of antimicrobial susceptibility patterns and the judicious use of antibiotics in clinical practice. They also underscore the importance of personalized treatment strategies, informed by local resistance patterns, to effectively manage UTIs and combat the growing challenge of antimicrobial resistance. Additionally, our study suggests that further research is necessary to explore the mechanisms of resistance and to develop new therapeutic strategies to address this evolving healthcare challenge.

Limitations of Study

1. **Single-Center Design:** The study was conducted in a single hospital setting, which may limit the generalizability of the findings to other hospitals or community settings. Different geographic locations may have varying antimicrobial resistance patterns.
2. **Sample Size:** Although a sample size of 200 is substantial, it may still be inadequate to capture the full spectrum of uropathogens and their resistance patterns. A larger sample size might provide a more comprehensive understanding.
3. **Cross-Sectional Nature:** As a cross-sectional study, it can identify associations but cannot establish causality. Longitudinal studies would be required to understand the dynamics of antimicrobial resistance over time.
4. **Selection Bias:** The study may have selection bias, as it only includes patients who sought care at the hospital. This might exclude milder cases of UTIs treated in outpatient or community settings.
5. **Lack of Molecular Characterization:** The study did not incorporate molecular methods to characterize the mechanisms of resistance, which would provide deeper insights into the spread and evolution of resistance genes.
6. **Exclusion of Certain Patient Groups:** Certain patient groups, such as those with chronic kidney disease or recent antimicrobial therapy, were excluded. This limits the study's applicability to all UTI patients.
7. **Possible Reporting Bias:** As with any observational study, there is a potential for reporting bias, especially in the collection of retrospective data from medical records.
8. **Antimicrobial Susceptibility Testing Limitations:** The study relied on disc diffusion methods for antimicrobial susceptibility testing, which, while standard, may not be as sensitive or comprehensive as other advanced methods like broth microdilution.

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